SPECIFICATION

ICEBREAKER AND CHANNEL HAVING THE ICEBREAKER

Field of the Invention

[0001]

The present invention relates to an icebreaker which can break through ice formed when water at a channel is frozen, and to a channel having the icebreaker.

Background Art

[0002]

For example, steel gates are disposed at a channel such as a canal in order to open/close the channel (See Document 1)

Patent Document 1: Japanese Patent Application (JP-A) Laid-Open No. 2002-285533.

Disclosure of the Invention

Problems to be Solved by the Invention

[0003]

Typically, power outputted from a motor or the like is used in order to open/close gates. However, when water at a channel is frozen in winter time, it often becomes difficult to open/close the gates smoothly.

[0004]

It is considered that certain types of apparatuses may be used in order to break through the ice. However, the operation requires much time and labors, and a high cost performance as well, which is not practical. Besides, it will take considerable time to open/close the gates.

[0005]

As a result of assiduous study for solving such a problem as described above with a conventional art, the present inventors have now completed the present invention. An object of the invention is to provide an icebreaker having a simple structure for breaking through ice formed at a channel, and a channel having the icebreaker.

[0006]

Means for Solving the Problems

The invention according to claim 1 is an icebreaker for breaking through an ice formed at a channel, comprising an expandable/shrinkable film body which is disposed along a wall surface of the channel, a fixing member for fixing the expandable/shrinkable film body to the wall surface, and an air-supply means for supplying air to between the expandable/shrinkable film body and the wall surface to inflate the expandable/shrinkable film body at the channel inner side.

[0007]

Next, an operation of the icebreaker according to claim 1 will be described.

[0008]

At an ordinary time, the expandable/shrinkable film body is disposed along the wall surface of the channel.

[0009]

When temperature goes down, and for example, ice is formed on the water surface of the channel, the air supplying means is operated to inflate the extendable and/or contractive film body.

[0010]

As a result, ice formed on the water surface is pressed by the inflating expandable/shrinkable film body and crashed (broken).

[0011]

After the expandable/shrinkable film body has been used, air is discharged from the expandable/shrinkable film body so that the expandable/shrinkable film body recovers its original shape such that it is disposed along the water surface of the channel.

[0012]

The invention according to claim 2 is the icebreaker according to claim 1, further comprising a lower film body provided in close contact with the wall surface, wherein the air-supplying means supplies air to between the expandable/shrinkable film body and the lower film body.

[0013]

Next, an operation of the icebreaker according to claim 2 will be

described.

[0014]

In accordance with the icebreaker according to claim 2, air is supplied to between the expandable/shrinkable film body and the lower film body to thereby inflate the expandable/shrinkable film body.

[0015]

Since air is supplied to between the expandable/shrinkable film body and the under film body, air tightness is significantly improved.

[0016]

Claim 3 is a channel provided with an ice breaker, comprising a channel, a gate for opening/closing the channel, and the ice breaker according to claim 1 or 2 disposed near the gate of the channel.

[0017]

Next, an operation of the channel having the icebreaker according to claim 3 will be described.

[0018]

When temperature goes down, and ice is formed on the water surface in vicinities of the gates, the air-supplying means is operated to inflate the expandable/shrinkable means.

[0019]

As a result, ice formed on the water surface is pressed by the inflating expandable/shrinkable means, and crashed (broken), whereby the gates can be

opened/closed.

Effect of the Invention

[0020]

As described above, the icebreaker of the present invention can provide an excellent effect in that, with a simple structure, the icebreaker can break through ice formed at a channel.

[0021]

Further, since the channel having the icebreaker of the present invention is structured as described above, an excellent effect is provided in that, with a simple structure, ice formed at a channel can be broken to open/close the gates freely.

Brief Description of the Drawings

[0022]

Fig. 1 is a cross-sectional view of a canal according to a first embodiment of the present invention;

Fig. 2 is a plan view of the canal;

Fig. 3 is a front view of an ice breaker main body;

Fig. 4 is a perspective view of an expandable/shrinkable film body;

Fig. 5 is a cross-sectional view of a portion at which the expandable/shrinkable film body is attached;

Fig. 6 is a cross-sectional view of an icebreaker main body;

Fig. 7 is a plan view of a canal in a state in which the icebreaker has

been inflated;

Fig. 8 is a cross-sectional view of the canal showing a state in which ice deposited at the surface of the expandable/shrinkable film body is being peeled off therefrom;

Fig. 9(A) is a cross-sectional view of an icebreaker main body according to a second embodiment of the present invention;

Fig. 9(B) is a front view of an edge portion of an air pipe;

Fig. 10 is a front view of an ice breaker main body according to another embodiment of the present invention; and

Fig. 11 is a plan view of a canal according to another embodiment of the present invention.

Best Mode for Carrying Out the Invention

[0023]

(First embodiment)

With reference to the drawings, a channel provided with an icebreaker according to a first embodiment of the present invention will be described hereinafter.

[0024]

As shown in Fig. 2, a canal 10 is equipped with a gate12 which is opened/closed in a direction of arrow C. In Fig. 2, the gate 12 drawn by a solid line represent a closed state of the canal 10, while the gate 12 drawn by a double-dashed line represents an opened state thereof.

[0025]

Wall surfaces 14 are formed by a material such as a concrete, and disposed at both sides of the canal 10. Icebreaker main bodies 16 are formed at the wall surfaces 14, respectively, at a side to which the gate 12 is opened.

[0026]

As shown in Figs. 1 and 3, each icebreaker main body 16 has a rectangular expandable/shrinkable film body 18 which is elongated in the horizontal direction (direction of arrow B in Fig. 3).

[0027]

As shown in Fig. 4, the expandable/shrinkable film body 18 is formed as a canvas-like member in which fabric materials 19a and 19b are woven in warp/weft directions and covered with an elastic member 21 such as a rubber provided thereon. The fabric materials 19a arranged in a warp direction (direction of arrow A corresponding to the vertical direction of the canal 10) extends in a wavy manner, and the fabric materials 19b arranged in a weft direction (direction of arrow B corresponding to the horizontal direction of the canal 10) extend substantially linearly.

[0028]

Consequently, the expandable/shrinkable film body 18 is not stretched so much in the direction of arrow B but can be stretched well in the direction of arrow A due to a linear expansion of the fabric materials 19a.

[0029]

As shown in Figs. 3 and 5, a built-in fitting 20 is disposed along an outer peripheral edge of the expandable/shrinkable film body 18 on each wall surfaces 14, and anchor bolts 22 are also arranged thereon so as to be spaced apart from each other at a predetermined interval thereon.

[0030]

The anchor bolts 22 are inserted into holes 15 formed on the wall surface 14. Due to a solidification of an adhesive (such as an epoxy resin) 17 with which the holes 15 are filled, the anchor bolts 22 are fixed to the wall surface 14.

[0031]

Further, the anchor bolts 22 are passed through the built-in fitting 20.

[0032]

An end portion of the extendable and/or contractive film body 18 is disposed on the built-in fitting 20, and the anchor bolts 22 are passed through the expandable/shrinkable film body 18.

[0033]

Tap fittings 24 are mounted on the expandable/shrinkable film body 18. Nuts 26 are screwed, through spring washers 25, onto upper end portions of the anchor bolts 22 which are passed through the tap fittings 24. The outer peripheral edge portion of the expandable/shrinkable film body 18 is thus nipped between the tap fittings 24 and the built-in fitting 20, and fixed to the wall surface 14.

[0034]

As shown in Fig. 6, an air pipe 28 is embedded in the wall surface 14.

[0035]

One end of the air pipe 28 is open toward the wall surface 14 to face the inner surface of the expandable/shrinkable film body 18.

[0036]

To the other side of the air pipe 28 are mounted an air-supply valve 30, an air-discharge valve 31, a compressor 32, a check valve 33, a pressure gage 34, and an open/close valve 35.

[0037]

When the air-discharge valve 31 is closed and the air-supply valve 30 is opened, air can be supplied from the compressor 32 into the expandable/shrinkable film body 18, and when the air-discharge valve 31 is opened, air can be discharged from the expandable/shrinkable film body 18.

[0038]

Moreover, the check valve 33 and the pressure gage 34 which are installed at the air pipe 28 are controlled to prevent a reverse flow of the supplied air and an excessive pressure. Pressure is checked by opening the open/close valve 35.

[0039]

Further, for the convenience in use, motor valves can be used as the air-supply valve 30 and the air-discharge valve 31.

(Operation)

Next, an operation of the present embodiment will be described.

[0040]

As shown in Figs. 1 and 2, at an ordinary time, the expandable/shrinkable film bodies 18 are disposed along the wall surfaces 14 of the canal 10. Accordingly, the gate 12 can be opened/closed smoothly.

[0041]

A water level of the canal 10 according to the present embodiment changes in a horizontal direction. In Fig. 1, a water level 34a drawn by a solid line shows a high water level, and a water level 34b drawn by a double-dashed line shows a low water level.

[0042]

For example, when the water level is high at the water level 34a and the temperature has dropped while the gate 12 is closed, whereby, as shown in Fig. 6, an ice 36 has been formed on the water surface 34 of the canal 10, air is supplied from the compressor 32 to the expandable/shrinkable film body 18. As a result, as shown in Fig. 7, the expandable/shrinkable film body 18 is inflated.

[0043]

For example, in a case in which the expandable/shrinkable film body 18 is sized to a width of 3200mm × a length of 915mm, if the pressure within the expandable/shrinkable film body 18 is about 30.0Kpa, the expandable/shrinkable film body 18 may be inflated by about 300mm at the

central portion thereof.

[0044]

By this, the ice 36 which is formed on the water surface of the water 34 is pressed by the inflating expandable/shrinkable film body 18 and crashed, whereby the gate 12 can be opened/closed smoothly.

[0045]

Since the working operation for crashing the ice 36 requires only the operations of the compressor 32, the air-supply valve 30 and the air-discharge valve 31, the ice 36 can be crashed easily.

[0046]

Needless to say, the icebreaker main body 16 must be set so as to meet the level of the water at which the ice 36 is formed, and the expandable/shrinkable film body 18 must be measured so as to reliably break the ice 36.

[0047]

After the use of the expandable/shrinkable film body 18, air is discharged from the expandable/shrinkable film body 18, whereby the expandable/shrinkable film body 18 recovers its original shape such that it is disposed along the wall surface 14.

[0048]

Since the expandable/shrinkable film body 18 is deformed or expanded by inflation, the expandable/shrinkable film body 18 thus inflated is returned to

the original flat shape by itself or by the shrinking force thereof when the air inside the expandable/shrinkable film body 18 is discharged.

[0049]

Further, air within the expandable/shrinkable film body 18 can be forcibly discharged by using a pump or the like.

[0050]

As shown in Fig. 8, there is a possibility that the ice 36 is deposited to the surface of the expandable/shrinkable film body 18 itself. In such a case, it suffices to simply inflate the expandable/shrinkable film body 18 in order to peel off and drop the ice 36 from the expandable/shrinkable film body 18.

[0051]

In the present embodiment, the icebreaker main body 16 is disposed only at the side to which the gate 12 is opened. However, the icebreaker main body 16 may further be added at the other side of the gate 12.

[0052]

Further, it is preferable to attach in advance a pressure control valve (not shown) to the compressor 32 in order to prevent an unnecessarily high pressure from acting on the expandable/shrinkable film member 18.

(Second embodiment)

With reference to the drawing, a channel having an icebreaker according to a second embodiment of the present invention will be described next. Further, portions identical to those in the first embodiment of the present invention are

denoted by the same reference numerals and descriptions thereof will be omitted.

[0053]

As shown in Fig. 9(A), in the icebreaker main body 16 according to the present embodiment, a lower film body 38, which is formed from an elastic body such as a rubber and which has the same size as that of the expandable/shrinkable film body 18, is provided so as to be in close contact with the wall surface 14, and the expandable/shrinkable film body 18 is mounted on the lower film body 38.

[0054]

Since no inflation of the lower film body 38 is carried out, it is unnecessary for the lower film body 38 to be capable of expanding as is the case with the expandable/shrinkable film body 18.

[0055]

Further, both the lower film body 38 and the expandable/shrinkable film body 18 are nipped between the built-in fitting 20 and the tap fittings 24, and fixed to the wall surface 14.

[0056]

As shown in Fig. 9(B), a flat donut-shaped fastening member 40 is embedded in the wall surface 14 at the end portion of the air pipe 28.

[0057]

A female thread 42 is formed at the inside of the flat donut-shaped

fastening member 40, and a male thread 46 of a tap fitting 44 is screwed through the lower film body 38 and a washer 45 into the female screw 42.

[0058]

The tap fitting 44 has a disk-shaped flange 48 whose diameter is larger than that of an annular seal rib 47 of the tap fitting 40, and the lower film body 38 is nipped between the tap fitting 40 and the washer 45.

[0059]

A through hole 50 for air communication is formed at the axial core portion of the tap fitting 44.

[0060]

In the present embodiment, the expandable/shrinkable film body 18 is brought into contact with the lower film body 38 as an elastic body, and a space into which air is blown is positioned between the expandable/shrinkable film body 18 as an elastic body and the lower film body as an elastic body. Thus, air tightness is very high and leakage of air can be reliably prevented.

[0061]

Consequently, the present invention can be suitably used when cracks are formed on the wall surface 14.

(Another embodiment)

In the above-described embodiment as shown in Fig. 3, the expandable/shrinkable film body 18 before being inflated has a flat rectangular configuration whose four corners have been chamfered. However, the flat

configuration of the expandable/shrinkable film body 18 is not limited to this, and, as shown in Fig. 10, it can be formed into another configuration such as a substantially O-shaped or an ellipsoidal configuration.

[0062]

Further, in the aforementioned embodiment, a recessed portion 52 for accommodating the gate 12 is formed at the wall surface 14 of the canal 10, and the icebreaker main body 16 is provided at the recessed portion 52. However, as shown in Fig. 11, the recessed portion 52 need not be formed at the wall surface 14.

Industrial Availability

The present invention can be applied, when water in a channel is frozen in winter time, in order to break ice formed at the channel with a simple structure so that a gate provided at the channel can be opened/closed.

Description of the reference numerals

[0064]

10 channel

12 gate

16 icebreaker main body (ice breaker)

28 air pipe (icebreaker)

30 air-supply valve (icebreaker)

31 air-discharge valve (icebreaker)

32 compressor (icebreaker)

33 check valve (icebreaker)